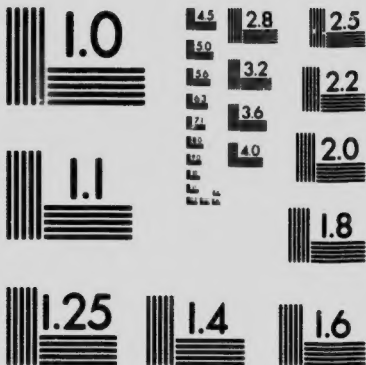




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Province of New Brunswick

DEPARTMENT OF AGRICULTURE

BULLETIN N^o. 1

Education for Agriculture

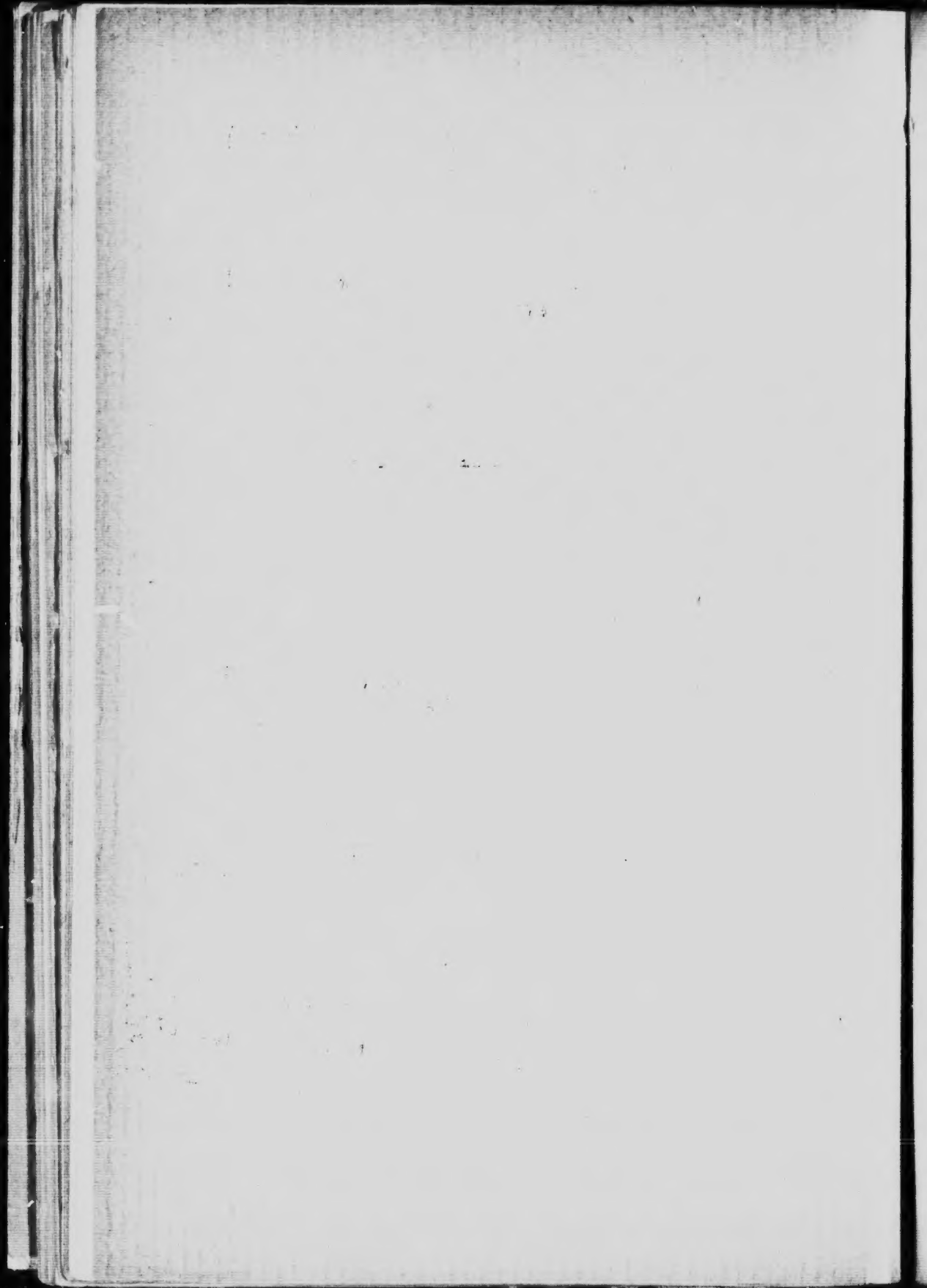
AN ADDRESS

DELIVERED BY

Dr. James W. Robertson,

*Principal of Macdonald College, Ste. Anne de Bellevue,
Que.,*

Before the Members of the Legislature of New
Brunswick, Fredericton, May 1908.



EDUCATION

—FOR THE—

Improvement of Agriculture

IN NEW BRUNSWICK.

By Dr. James W. Robertson,

PRINCIPAL OF MACDONALD COLLEGE, STE-ANNE DE BELLEVUE, QUE.

MR. CHAIRMAN AND GENTLEMEN :

I thank you, Sir, as Commissiener for Agriculture for this Province, for the compliment you have paid Macdonald College in asking me to come and speak in this chamber, to the Members of the House and others assembled here upon agriculture in New Brunswick. I feel that the subject of agriculture in an abstract, far-off, academic way would have no special interest for you ; but as a public and private activity, its condition and the conditions of those directly engaged in it affect to some extent the welfare and prospects of every citizen of the Province. This portion of the Dominion has made real progress in education and in agriculture ; and upon these two activities depend, in a fundamental way, the prosperity of this portion of this Dominion and of the whole of Canada. Some things are trivial, transient and only local ; but the improvement of agriculture concerns the welfare of every industry, every profession, every occupation, every interest in our whole land ; and to me the improvement of agriculture seems impossible except by the advancement of education.

Some Natural Resources

In this Province there are varied and valuable agricultural resources hardly known by its own people. Over in Nova Scotia the apple barrel looms big ; you hear the apple business spoken of as a great industry ; but the hens of that Province are greater producers in the aggregate than the apple trees with their beautiful and wholesome fruit. There are resources in this Province that are exhaustible and resources that are inexhaustible except through waste, indolence or greed, and these result from ignorance of the people. Education is the protection, the preventive and the cure.

The forest resources of this Province are great and valuable, and while exhaustible they can be restored and improved by intelligent management. The restorative process is part of agriculture in the wide sense, because such trees are products of intelligent culture. There are resources in this Province that are exhaustible and not restorable, such as your mineral resources. When these are gone, they are gone forever. It has been stated that the coal fields of the United States at the present rate of consumption will not last more than seventy-five years. When you conserve your forests, you conserve the water supply for streams as well as for crops, and water power will largely take the place of coal. Now that electricity is coming into common use, water powers are a great national asset. Agriculture, forestry and water powers are linked together, and the progress of the one means the progress of the other. These are resources which may be made inexhaustible and continuously enhanced by good management.

The census returns gave 37,583 occupiers of land, with 4,443,400 acres. Of that area, 1,087,626 acres were returned as under all crops in 1907. In round figures the value of land, buildings, implements, machinery and live stock is \$51,000,000. The total annual value of all crops and products is recorded as \$12,894,076 in 1901. It is estimated to have risen as high as \$15,000,000. The value of the fish products amounts to about \$4,500,000 annually ; the miner-

al products to about \$650,000 ; the forest products were estimated at the late Forestry Convention in this city at about \$10,000,000 annually.

Your Greatest Asset

While there has been substantial progress in many respects in New Brunswick, the Province has practically stood still for thirty years in the number of people occupying land. The Province could sustain no greater loss than a reduction in its rural population, for an intelligent, prosperous and contented rural population is the greatest asset of any state.

"Ill fares the land to hastening ills a prey,
Where wealth accumulates and men decay."

Young men have been leaving the rural districts in large numbers every year. I will not say one disparaging word as to the attractions which have drawn them elsewhere ; but where the strong, vigorous, enterprising and ambitious young men and women continue to leave for twenty to thirty years the human life of the locality is left greatly weakened. There was a heap of skulls from France in Northern Italy, and a sprinkling of bleached bones from Napoleon's army in retreat from the frozen steppes of Russia which together left degeneration in France. When Napoleon robbed the land of its best youth and left their bodies in trenches from Egypt to Waterloo, what could be expected but a Sedan and the decadence from which France is only now recovering. The well-born, well-bred and well-educated youth are our best asset. If the education of the schools beguiles them to leave you in large number for foreign lands, you should change the education. If the West lures them you should give them correct information about the West,—and also sound information, interpreted with insight, about New Brunswick. It is also important that varied and reliable information regarding New Brunswick should be put systematically and extensively before the people of Great Britain.

For myself, were I, even with my present knowledge of Canada, now coming to the Dominion as a new settler, I

would rather come to the Maritime Provinces to make a home for myself than try the fortunes of the West. Here one finds invigorating climate, good schools, a law-repecting population, with high ideals and standards of life, running streams, plenty of trees, the fragrance of clover blossoms and flowers, fresh fruits and innumerable other satisfactions. In brief, here is a satisfying place in which to found a home.

I have discussed with leading men from England the desirability of directing a portion of the stream of immigration into the Maritime Provinces. There might not be during the first few years such a rapid accumulation of available wealth as from prairie farming, but there might be general success with few failures. The land is suitable for growing almost every crop of the Northern temperate zone. It has a climate healthful and reliable as to rain-fall and temperature, and good markets for all classes of products at the doors.

Some Results from School Gardens

In the agriculture of this Province the production of field crops has relatively greater importance than in some other parts of Canada where live-stock interests or dairying have been extensively developed. On the average, for every \$5.00 of revenue from all the agricultural products of New Brunswick about \$3.00 come from the field crops; 90 c. from dairying products; 80 c. from live stock, meat products and wool; 15 c. from poultry and eggs, and 15 c. from all the rest put together. There is room for great improvement in the production of field crops, as well as of the secondary products which can be obtained from the use of them. Let me cite an instance of what might be done in the matter of the potato crop.

The yield of potatoes for the season of 1906 was estimated at 9,139,022 bushels. Might I illustrate by quoting the results of experiments and experience at some of the twenty-nine School Gardens which were established under the Macdonald Rural Schools Fund?

At most of the gardens two plots, side by side, were planted with potatoes under similar conditions. The treatment of both plots was alike, except in regard to the spraying with Bordeaux mixture to prevent blight. One plot in each garden was sprayed with the mixture, three or five times, as the case might require, whereas the other plot was left unsprayed. In every case the yield of potatoes from the sprayed plot was larger than the other. The following list shows the increased yield resulting from spraying at six gardens: Knowlton, Que., 111 per cent. Richmond, Ont., 100 per cent; Carp, Ont., 85 per cent; March, Ont., 81 per cent, Guelph, Ont., 43 per cent; Brome, Que., 41 per cent.

If an increase of 40% could be obtained (that is less than the lowest of the School Gardens) think what an immense addition to the value of the crop in New Brunswick that would bring; and such a result, in a very large way, has been revealed at Bowesville in Ontario. In that locality the potato industry has been put on a new footing of profit by the work done at the Macdonald School Garden in the locality. I take the following extract from the report of the Principal of that School, not only in regard to the potato crop, but in regard to all ordinary crops on the farms:

"Bowesville, Ont., which is situated six miles south of the Dominion capital, has long been regarded as one of the most progressive sections in the progressive County of Carleton, and it is to the active interest of its people in the welfare of their school that the credit for a large measure of the success of the movement here is due. They have never interfered but to aid. Land sufficient to make a school ground comprising two and one-half acres was purchased and this was enclosed by a neat fence with turned posts and attractive gates.

"The daily attendance at Bowesville school may be placed at approximately fifty children, ages ranging from six to sixteen. The plan of dual ownership of garden plots has been followed here, a senior and junior pupil having joint ownership in a piece of ground (ten feet by twenty feet), working in conjunction and making a just division of the spoils at time of harvest. This plan gets over the difficulty experienced when juniors are shouldered with the entire responsibility of managing a plot, while it does not

destroy the sense of ownership which makes proud the juvenile gardener. In laying out and cultivating the garden plots the entire work, with the exception of the ploughing of the ground, was performed by the children, and, it may be added, cheerfully performed. Neighbouring farmers brought manure for the garden and ploughed the ground.

"The experimental plots, belonging to the senior class, deserve special notice. Experiments in crop rotation, in the effect of clover growth, and in potato spraying have been carried on, and results carefully noted. Bowesville is the centre of the largest potato producing section in eastern Canada, so particular attention was paid to potato spraying experiments. In addition to the class experimental plots mentioned, three of the oldest pupils carried on an independent experiment in spraying. Care was taken that the crop received neither more nor less attention, other than the spraying, than did the crop in a neighbouring field. Rows of potatoes sprayed with Bordeaux mixture were grown beside rows receiving ordinary attention. When the resulting crops were piled side by side in the tool-house, showing an increase equivalent to more than fifty bushels per acre for the sprayed over the unsprayed crops and also a decided improvement in size and quality, the farmers sat up and did more thinking than would have been the case had they read of the same results in some agricultural publication. It is not so much what these plots teach as it is the trend of thought induced."

At the school gardens an effort is being made to give the children information and training in three important matters in connection with agriculture, viz., the selection of seed, the rotation of crops, and the protection of crops against disease and insects. It is really industrial education. Children find out something by doing, observing, and recording results themselves, and I say it over again that all worthy progress, in matters that are worthy of thinking about, springs from learning the lessons of consequences. As soon as a child understands that, and governs his life accordingly, he becomes a better pupil and the promise of a better citizen in every sense.

The school garden is one way of making rural life more attractive as well as efficient. It may be the first step towards actuating the people to pay more to make the schools more efficient. The best education in rural schools should make

the people like rural life and also enable them to make it more profitable. The best way to make any workman like his work is to make him understand it. The beginnings of all that and much more are laid in the schools.

I cite only a few other instances of the results from the experimental plots in the gardens managed by the children themselves. In Prince Edward Island, at Tryon, the children obtained an increase of 32 per cent, in the yield of wheat from a plot on which selected seed was sown, as compared with a plot alongside for which the seed had not been specially selected. In Prince Edward Island, also, the children obtained a yield of 17 per cent increase in a barley plot after clover, as compared with a plot alongside where no clover had been grown.

Improvement of Seed Grain

Immense improvements in the quality and quantity of the crops can be obtained by systematic selection of seed. At the risk of repeating what some of you already know, it is worth while reciting what was done by means of the MacDonald Seed Grain Competition as carried on by boys and girls on farms dotted all over Canada from the Atlantic to the Pacific.

The main purpose of this movement was to improve the crops of Canada by encouraging the general use of seed improved by selection from varieties of which the product is in demand or has a relatively high market value. The use of such seed increases the quantity of produce per acre; makes the quality better, and thus renders rural occupations more profitable and the people who follow them more prosperous and more contented. In growing crops two fundamental principles should be recognized: 1. The relative measure of success with which crops obtain their food from the soil and the air is determined by their environment—their opportunities. These opportunities depend primarily on the climate or weather as well as on the soil, and are modified largely by cultivation, particularly by a suitable rotation of

crops, by manuring and by drainage. 2. The relative measure of success with which crops obtain their food from the soil and the air is determined by the power of each individual plant to take in, absorb and assimilate food from the soil and the air, the power of the plant to overcome obstacles and the ability of the plant to do things in its own environment. A plant is a living and working organism. Its capacity to live and assimilate is largely determined by the source whence it inherited its qualities.

In the summer of 1893 I put aside \$100—my own money, not the public funds—to offer in prizes to Canadian boys and girls who would send me the largest heads from the most vigorous plants of wheat and oats from their fathers' farms, partly to learn whether the country could be got ready to accept the principle and adopt the practice, and partly to interest and educate the boys and girls. I had a wonderful response, and I paid the money in prizes with as much enjoyment as any money I ever spent. The letters I got from farmers and from their boys and girls were so suggestive and encouraging that in the following winter I went to my friend Sir William C. Macdonald, of Montreal, and said in substance: "Here is a great chance to do some educational work in progressive agriculture; to do something interesting, something attractive, something definite, something beneficial to the whole community, something easy and yet with plenty of difficulties. Farmers and their families may fail to appreciate the educational advantages of a plan or scheme set out in a written statement, but here is something which would be so helpful and instructive to boys and girls that they would go on with it, and the habits of observation and thought and study would go on with them." I told him \$10,000 for prizes would set and keep this thing going for three years. He provided the money with all goodwill—my little \$100 come back a hundred fold—to offer as prizes to boys and girls to encourage them to carry out in practice the plan of selecting the largest heads of the most vigorous plants and growing seed from those heads on a plot by itself.

The yields from the crops of 1930 compared with those of 1923, on an average for all Canada for spring wheat, showed an increase of 18 per cent in the number of grains per hundred heads, and 28 per cent of increase in the weight of grains per hundred heads. In oats the figures were 19 per cent of increase in the number of grains per hundred heads, and 27 per cent of increase in the weight of grains per hundred heads. These are results from several hundred seed grain plots operated by boys and girls. Altogether over 1,500 entries were received. Out of that number 800 completed in full the first year's work, and 450 of them completed the three years' work in a satisfactory manner. The operations of the competitors were inspected from time to time during the term; the parents of the 450 competitors who completed the three years' work were found, as a rule, to be among the best farmers in the localities where they resided. Ninety two per cent of the reports said on behalf of parents and guardians that the quarter acre hand-selected seed plots carried crops decidedly more vigorous and heavy than the crops from the same varieties of grain grown on the same farm in the same season from unselected seed. The plots and farms with these seed grain plots were visited in many cases by an official of the department. It was learned from them, from the operators themselves, and from neighbouring farmers, that the crops grown on these hand-selected seed plots were heavier and better, and that the plants in them were more vigorous than those produced on the other parts of the farm from the ordinary seed of the same variety without systematic selection.

Some Remarkable Gains

As direct and indirect results of that competition there has been a remarkable development in the cultivation and systematic selection of grain of high quality for seed. The Seed Branch of the Department of Agriculture itself was a direct outcome of the Macdonald seed grain competition. Parliament votes over \$50,000 per annum to carry on the work of that Branch, for the improvement of seed and the

securing to the farmers by legislation and inspection of reasonably clean grass seed and clover seed.

Many of the farmers on whose farms the competition was carried on were formed into the Macdonald-Robertson Seed Growers' Association, out of which grew the Canadian Seed Growers' Association. Its third annual meeting was held in June, 1906, and the report of its proceedings contained a marvellous record of valuable public service. Particular information was obtained from leading members of the association. These reported several distinct and definite gains from the method of selection which had been followed by the members of the association, viz., the size and quality of the kernels definitely improving; the strains of selected seed maturing more evenly; the strains becoming better adapted to local conditions; varieties being kept pure; the strains becoming more resistant to disease and gaining in productiveness. All these are highly desirable and give added value to the crops in every case.

I made enquiries last year from the Seed Branch of the Department of Agriculture and from members of the Canadian Seed Growers' Association. I gathered from their estimates that one of the direct results from the seed grain competition was an increase in the value of the grain crops of 1906, to those who were directly affected by the seed grain prizes, to the extent of at least \$500,000. That is high finance for you, high finance by a man of lofty intelligence and spirit—5,000 per cent. on an investment of \$10,000; and the best of it all is that Sir William Macdonald has not sought and did not receive a single dollar of return for himself from it. That is laying up treasures where neither moth nor rust doth corrupt and which go on gathering and diffusing benefits for ever and for ever for the people.

Work of great national value along similar lines has been carried on at the Dominion Experimental Farms and on the Experimental Farm at the Ontario Agricultural College.

With Mr. C. A. Zavitz, Professor of Field Husbandry at the Ontario Agricultural College, I followed a case where

he planted one specially selected seed in 1905. —I saw an acre of barley from that seed growing in 1905. Another remarkable instance of the improvements by Mr Zavitz may be named here. For twelve years he had selections made of Joannette oats; on the one hand there was selected seed, large, plump and of dark colour; on the other hand, there was selected seed, thin, light and of light colour. A similar selection from each crop was made year by year for twelve years.

The result was that at the end of twelve years the crop from the large, plump, dark-colored seed yielded 26.1 bushels per acre more than the crop from the light, thin seed of light colour. The conditions of soil and weather for both crops were alike. Moreover, the grain from the large, dark-coloured seed weighed 10.5 pounds per bushel more than the other.

Most notable are the results of the increases in the yield per acre of cereals in the Province of Ontario. In comparing the yield per acre for the ten-year period 1887 to 1896 inclusive with the yield of the following ten-year period, 1897 to 1906 inclusive, it was found in the winter wheat the increase per acre had been at the rate of 13 per cent; in oats 18.9 per cent. and in barley at the rate of 23.4 per cent. If a similar rate of increase were applied to the cereal crops of New Brunswick it would mean an additional revenue of over \$500,000 per annum, without any increase in the acreage under cultivation. For that there need be no more ploughing done, no more horse-power applied, no more money; just more intelligence and good management, more adaptation of effort to meet the conditions in the locality. Whenever a farmer begins to obtain larger crops of better quality he stimulates his neighbors to strive in the same direction, and then together they increase the area under crop, as well as obtain larger yields from every acre. The selection of seed is one of the means whereby agriculture can be greatly advanced. It is one of the features of what has been called the *Macdonald Triad* of good farming, namely, the sowing

of selected seed on properly prepared soil, the intelligent rotation of crops and the protection of crops against weeds, insects and disease.

The Value of Clover

The fertility of soil depends not alone on its composition, but also on the condition of the various constituents of plant food contained in it. It is governed also, to a large extent, by the number and activity of the germs or bacteria in the soil.

One of the effective means of improving all soils which have been cropped for many years, is to add humus in some form. Humus may be called the decaying parts of plants. Where cattle are kept a quantity of it may be provided in the manure and litter from the stables. It may be also provided from the residuum of crops, in roots or ungathered leaves. One of the profitable ways of adding it to soil is by growth of clover crops. Clover may be called an improving crop, or a crop possessing great power to restore fertility to worn-out soils. In the Old Countries it has been used for that purpose from time immemorial. While it contains in itself, and removes from the land where it is grown a large amount of nitrogen, it still leaves that land richer in nitrogen than it was before. At the famous Rothamsted Experiment Station in England, a part of a field bore a crop of barley and another part of it carried a crop of clover. The barley crop removed nitrogen at the rate of 37.3 pounds per acre, while the clover crop removed nitrogen at the rate of 151.3 pounds per acre. That is to say, the clover crop took away from the land rather more than four times as much nitrogen as the barley crop. The following year barley was sown over the whole field, and the crop grown on the part of the field where clover had been a year before yielded 77 per cent. more than the crop from the part of the field where barley had been grown the previous year. The removal of nitrogen from the land by the clover crop did not impoverish it, but, on the contrary, the growth of the clover left it enriched for the following crop of grain.

The rotation of crops

The productiveness of the soil depends upon the substances present in the soil, and still more on the condition of the substances as to availability. That is where and how the rotation of crops comes in, and can be of very great benefit to the farmer who understands the underlying principle, or at least follows the practice. Some crops by growing on land not merely give a good return in themselves, but they make available in the soil the plant-food that the succeeding or some succeeding crop needs and can get in better form through their action.

It is admitted that the rotation of crops has been the chief means of improving the agriculture of Great Britain and some other parts of Europe during last century. The practice itself consists in growing roots (or some other cultivated green crop), and leguminous crops (such as clover, beans or pease), or grass (or hay crops), alternately with cereal crops ripened for grain. The famous four course Norfolk rotation was roots, barley, clover or beans and wheat. The chief point seems to be to make those crops follow each other which have different requirements, as to the time of the season when they benefit most by plenty of available plant-food in the soil and different habits of growth in other respects, particularly in the ranges of their roots. The rotation for any farm must have regard to the soil, the climate, the markets for rotation crops, and other local conditions. Not only the increase in the yield of crops has to be taken into account, but also the value and uses to which the crops can be put when grown.

Clover is a most valuable crop as one in a short rotation. It increases the substances of plant food in the soil for cereals, and makes conditions suitable for the activity of such germs in the soil as prepare other substances for the use of subsequent crops. The use of a clover crop, or some other plant of the same family—one of the legumes—in a rotation, has been demonstrated as the best farm practice. In an

experiment extending over thirty-two years at Rothamsted, the records show an increased yield of wheat amounting to 114 per cent. when one crop in the rotation included clover or beans, as compared with the yield from wheat when cereal crops followed cereal crops.

The results on the experimental farms of Canada show that the yield of grains (wheat, oats or barley) after clover is from two to ten bushels per acre more than the yield of grain in the same season from grain after grain. It is not by getting commercial or other material fertilisers and using them on the land, but by fertilising the intelligence of the people through the medium of the common schools, that the greatest improvements in the fertility of the fields are to be made.

The great increase in crops grown in rotation over those grown continuously seems to be because more nitrogen is available to the former; and perhaps because it is available during the early period of their growth, from the preparation of it by the preceding crop or by the cultivation of that crop. Other benefits from systematic rotation of crops are (1) the distribution of the mechanical operations of the farm over the season; (2) the opportunity for cleaning the land; (3) the comparative freedom from damage by insects; and (4) the production of a variety of products for feeding to live stock and for sale.

The two processes of increase

In the growth of all plants that form farm crops there seem to be two processes that govern the increase; and the understanding of the principles of these will, I think, help any farmer and every farmer to form rotations for himself that will be exceedingly valuable; whilst without an understanding of these principles he will be always groping in the dark after the best methods. In the growth of plants one set of conditions make for increase in the size of the roots and the stems and the leaves. These are the vegetative part—the part of the plant that perishes utterly when the plant

dies. There is another part of the plant that does not perish when the growth ends, viz., the seed that carries the life over to the next crop. The conditions which make for the enlargement of the roots and the stems and the leaves, do not make for increased production of seeds. The set of conditions favourable for continued increase in size of root and size of stem and size of leaf do not make for increase in the quantity of seeds, but rather for the opposite. The extension of the vegetative stages of development—for the formation of roots, stems and leaves—is at the expense of the development of the reproductive parts—the seeds. Take the instance of a bunch of oats growing in a dung-hill ; what happens ? A very large root, a grossly large stem, broad long leaves, and very, very, very few seeds in the head. That is to say, the conditions that make for the continued enlargement of the root, the increase of the stem, an extension of the leaf do not make for an increase in number and weight of the seeds. That is an extreme case, but it reveals a principle. Now, take another set of extreme conditions, where a plant can grow only with difficulty, either in root or stem or leaf. Look on a bare roadside, where a small grass plant tries to form seeds when only three or four inches high ; then count the percentage of weight of the whole plant made up of the seeds ; and you have a revelation on the other side. The conditions that make it difficult for a plant to grow a larger root and a larger stem and larger leaves after the time of ripening has come, make for the increase of the number of seeds and the increase of the proportion of weight they bear to that of the whole plant. Of course, the conditions that make for the increase of size of root and size of stalk and size of leaf up to a certain point, also make for the increase of seeds ; because the seeds are formed out of what the plant takes in, through its leaves and roots. But when there is an excess of available plant food in the soil, only late in the growing and maturing period of the plant, that may prevent seeds from forming plentifully and ripening thoroughly. That is what happens frequently when farm-

yard manure is ploughed in, in the spring, for a grain crop in Canada.

In some plants the farmer wants a large root and large stem and large leaf; and in others he wants only the seeds—the other parts being an unimportant and secondary consideration. An abundance of plant food, an excess of it if you will, early in the life of the plant, makes for the growth of roots and stem and leaves; and then after the plant is about full size, some difficulty in getting more of it, makes for the growth of seeds. If a man wants large turnips let him pile on the manure. You never saw too much manure on a turnip field, for the size of the turnips. That is quite unlike the bunch of oats on the dung hill. Then you never saw a hay field over manured, so far as the growth was concerned. In the hay you want the stem and leaf and in the turnip and mangel and carrot you want the root; therefore, heavy manuring is the right thing for them. Besides their period of growth and accumulation extends many weeks after the period of collection by ripening cereals has ended; and that at a time when the farmyard manure applied that season is most readily available; and when nitrification in the soil is most active.

There is a fundamental principle to guide in making a rotation of crops,—apply manure for green crops and hay; and follow these by cereals sown in soil having a very fine tilth, since for them there is only a short growing season. That the early first part of it should be favourable is most important for the yield of grain.

Application of farmyard manure directly for grain crops is almost always a wasteful practice; but put on for root or other green crops it puts and leaves the soil in the best condition for grain crops to follow. I do not contend for sowing grain on poor land, but for putting manure on for green crops and for grass and for hay, which take all the nourishment they require; and leave enough, and that in the best condition, for the growth of the succeeding crop of grain.

How Plant Food Is Prepared

Another illustration must necessarily be a short one. It will throw a little light on how plants are nourished. I take this body of men as representing the high intelligence of the province. I do that not only because there are representatives of the Legislature present, but because the others here are picked men. Only a few years ago few of us knew the meaning of the life of germs in the soil which make it fit to carry crops. I do not refer to the materials in the soil, but to the life content of the soil. Every animal is nourished by processes which may be considered under three stages at least. Whatever the animal may swallow at first lies outside its body, strictly speaking. Take the earth worm: The soil may have passed through the creature, but was not in the creature itself. Our food in the same way goes into a tube and some of it passes through the body without having become part of the body. Before the food that is swallowed is taken up into the juices of the body it must be in a state of solution. Even the starch contained in the bread that we eat must be converted into a soluble state before it goes into the juices of the body. After it gets into the juices of the body it is said to be absorbed, but is not then assimilated into the structure of the body. You may have the worst kind of ill-health from having things absorbed without being assimilated. I once fed a lot of pigs which I took from the same families, and put into different pens. To some of them I gave food that was not adequate food for growth and health; and the pigs in that pen were weak and down with nervous prostration in three months. When a lot of stuff, absorbed into the system, is not assimilated, the system has to get rid of it somehow, which is not easy to do. When a tree grows it depends upon similar processes for its support and nutrition. Everything that goes to the promotion of the growth of the tree must first be reduced to solution, in a liquid or gaseous form. What makes the materials of the food of plants contained in the soil soluble? The activity, the work of the lowly forms of life which exist there. Every

particle of food that a tree or a plant gets out of the soil in a soluble condition has been rendered so by some lowly form of life that made it fit for the roots of the plant to take it in. It is a known fact that an apple orchard in grass land does not thrive: what is the explanation? If you make an examination of the soil you will find that the minute forms of life in the soil of the sod-land, are not more than one-twentieth as plentiful as in a field that is cultivated. The processes of cultivation introduce substances and conditions into the ground favorable for these low forms of life to live and multiply. They in turn prepare the food for the trees and other cultivated plants. They are the cooks of the plant food in the soil.

A Fair chance for the Boys and the Bacteria.

Suppose a boy knew all about that, by instruction, observation, experiment, and training, would he not cultivate the land that he had to manage so as to make it more fertile? He would grow clover at the right time, and would have the proper rotation of crops, and would have his land sweet and in good condition of tilth. If land is sour you put on lime to sweeten it, and usually to sweeten life for the soil microbes that they may labor comfortably. Some years ago I had sent to me from England a formula for making of compost that was said to be over 250 years old and to come from Somersetshire, famous for its dairy products. The formula was to take so many cartloads of dust from the high-road, so many loads of turf, and so many bushels of lime, make them into a heap and turn them over twice or more. When such a compost was put on the land it was said that it made a tremendous difference in the crop. I showed the formula to an eminent chemist, who after examining it, said it was worth nothing; that it was like the old superstition as to the virtue of killing pigs in certain phases of the moon.

And yet there was the experience of 250 years, as shown by the traditions and records; but he said the formula did not add anything to the land but lime, and that did not count for much because the land might have it already. On the

other hand, take a man who has studied the lower forms of life and wants to make a culture of soil bacteria ; what does he do ? He may take sod and road dust—and there is nothing better than road dust—and put in some lime. He will make a culture—what the dairyman would call a "starter." This old Somersetshire compost was a culture, a starter, promoting the growth of low forms of life that would work like Trojans in preparing soil food for plants. I have seen men with a waggon take three bags of earth from one piece of ground to sow on another piece of ground that would not grow clover ; and the following year the clover grew luxuriantly. In taking this earth from the one piece of land to the other the men were seeding the land to which the earth was taken with bacteria. Some times if clover will not thrive the first year it will do better the second year ; the reason for its not doing so well the first year being that the low forms of life were not abundant enough, or perhaps that the particular germ which lives in clover roots was not present in the soil. If you pull up clover and examine the roots you will find little nodules or tubercles containing low forms of life. These low forms of life are an agency by which the land is made rich by taking in free nitrogen from the atmosphere. An eminent French chemist is reported to have made cultures of soil bacteria which have enriched the land in nitrogen content, apart from the growing of clover. What is the possibility of this thing ? I am not speaking of theory, but of what is known as fact. Do not the people of New Brunswick want to have, for their boys and girls, the sort of knowledge that makes for an understanding of life and that makes for the ability to manage life on the farm, life in the soil, in the plants, and in the animals and their products ? Do they not need that in this province ? They do need it ; and they can get it by the proper organization of the educational means at hand.

About Live Stock, chiefly Poultry.

I have said nothing about, nor shall I at this time attempt to discuss, the improvement of the live-stock industry in the

province. Already a good deal has been undertaken and accomplished in the province in the way of improving horses. The details of the methods may be open for discussion, but those do not concern us at the present time. Good horses have been brought into the province; the people have been encouraged to observe, to discuss, and to do a great deal for themselves. Some systematic work has also been taken up for the improvement and extension of dairying in the province. That has great possibilities before it; it has not advanced in this province as in the Provinces of Quebec and Ontario, but it offers good avenues for profitable labor, particularly to those who have large families and plenty of available labor for the care of the cattle and the care of the milk. Where farm labor becomes scarce it is with reluctance that we become tied to the labor that comes every morning and every evening seven days of the week. The province is admirably adapted in many parts for sheep farming in a large way, and even in a small way they can be kept on farms as one branch of mixed farming.

The people of this province do hardly anything in the way of poultry-keeping for the production of eggs or the production of poultry for the table. As I have already mentioned, 15c out of every \$5.00 of total revenue from agricultural products is to be credited to the poultry. The whole industry might be evolutionized with great benefit to all concerned. I believe the taste of the people and the demands of the market will turn more and more towards poultry instead of the coarser meats. A good farmer can produce a pound of poultry at less cost than a pound of beef, and the pound of poultry will then sell for more money. As an instance of this, although one must not base a general conclusion on a single instance, I know of one of the leading dairy farmers of Ayrshire, Scotland, who has turned his whole place into a poultry farm, having disposed of his herd of dairy cows. He reports now as making much more money and having a more satisfying occupation.

At Macdonald College we now have some 240 pullets purchased last autumn (1906) from two of these poultry sta-

tions which had been maintained by the Dominion government. The pullets which we obtained were the selections of the fourth year from hens which were good layers during the winters, and which had vigorous constitutions. At Ste. Anne de Bellevue we have a climate not any milder than that of New Brunswick. For our poultry department we have erected one good substantial fire-proof building for office, classrooms, judging room and incubator rooms. I have never seen any buildings at any of the great institutions, devoted to the improvement of agriculture and the advancement of agricultural education, which are nearly the equal of ours at Ste Anne's ; and the poultry buildings of the Macdonald College match the others for their purposes, particularly for the students who will take the short or long courses. The fine buildings are for the students. But it does not follow that we should put hens in fire-proof buildings and heat those also by steam or by stoves. We put the hens in small colony houses. The largest of these are 20 feet x 14 feet x 7 feet high. These accommodate from 50 to 75 hens each. We have smaller colony houses, 12 feet x 8 feet x 7 feet high, which serve for 25 hens each. These colony houses stood unsheltered in an open field all through the winter. They are constructed of wood, one board thick, except at the end where the roosts are placed, and there there are two thicknesses of inch boards with tar paper between. Our 240 pullets did not get into their quarters until some time in November. They began to lay a few eggs on the 19th. November, and kept on improving on that all winter. As I have said, the colony houses are only one board thick, and occasionally the thermometer inside the house registered as low as 18° below zero.

The hens never got any cooked food or any troublesome mash ; they got no concoctions with pepper in them—I think pepper is the hen's whisky, and whisky does not make for good products. These hens are fed once a day on a mixture of dry grain, containing wheat, oats, barley, buckwheat and corn. That is thrown on the floor which already has a depth of three or four inches of cut straw and roughage. The

hens have access to a small trough at the bottom of a hopper containing either bran or crushed wheat. They have also access at all times to grit, oyster shells and meat scraps from the packing house. The winter was an exceedingly severe one. When the weather became cold and the water was frozen up in the colony houses, we stopped supplying water and let the hens pick snow instead. These are the simple conditions under which these 240 hens have spent the winter at the Macdonald College. You will have come to the conclusion, to which others jumped, that we did not get many eggs, and that the hens suffered from frozen toes and other injuries.

At Macdonald College, as a result of industrial and agricultural education, the result of lessons in consequences, a result of trials to find out what to do and how to do it with the best results, we had 240 hens in these small colony houses scratching for their dry food, fed once a day and picking snow. As I have said, the thermometer ran down occasionally to 15° and 18° below zero Fahr. In the severest weather a cotton curtain was unrolled at night in front of the perches. The hens had no other protection beyond that and the one-board thick colony house. There was no sickness except in the case of two hens which the man in charge told me dropped off the perch from apoplexy, being too fat. These two were not laying any eggs. But in the case of the other hens, while everyone did not lay during the winter, we obtained between the 19th. November and the 31st. March over 10,000 eggs—to be exact, 10,122 eggs. In the coldest weather we got about six dozen eggs per day, and have been getting about 150 per day in the milder weather. Then, when we put the eggs from these hens in the incubators they tested quite high for fertility, the range being from 93 to 76 per cent fertile. The feed consumed by these 240 hens during the winter cost altogether \$117. These hens are the product of four years' selection, and in the four breeds kept there is not much difference in the results obtained. Twenty-five Rhode Island Reds laid on an average 51 eggs per hen; 25 Buff Orpingtons, 40 eggs per hen; 100 Plymouth Rocks,

40 eggs per hen, and 100 White Wyandotte, 39 eggs per hen, between the middle of November and the end of March. Two hens laid 83 and 85 eggs respectively. Seventy hens laid over 50 eggs each. Fifty-three laid less than 20 each, and thirteen did not lay any. Some of them had not responded to the industrial and agricultural education which had been provided. They consumed altogether from the 1st. of November, 1906, until the end of March 1907 :

Mixed grain (wheat, oats, barley, buckwheat, corn)	6,100 lbs.
Wheat bran,	1,000 "
Skim-milk,	200 "
Beef scrap,	300 "
Grit and oyster shell,	300 "
Mangolds	(Not weighed.)

From November until March it cost us \$117 for the grain, grit, beef scrap, oyster shells and the skim-milk, and we sold about \$320 worth of eggs. We could have sold at higher prices. The price was 25 cents a dozen to our own people on the place and 50 cents to city people. We will do better when we are fully organised in reducing the cost of feed, in getting more eggs per hen and in the price.

Eggs from Frosted Wheat

During the last winter, that of 1907-08, we had some 680 hens. They lived in single-board colony houses, and came out very well throughout the winter in the laying of eggs. We had hardly any sickness and no disease. At one time during the winter the thermometer dropped as low as 22 below zero. By using trap nests, from which the hens are released when the man goes his rounds two or three times a day, the eggs are kept from freezing.

We have two rows of trap nests along one side ; after the hen gets in she cannot get out until released. The man goes around twice in the forenoon and lets the hens out. He sees the number on the band of the hen's leg, and pencils it on the egg. The hen sits on the nest until released. It was rather a bother at first, but it works well. We get the record of the hen and she protects the egg. A record can be kept of every hen.

As one of our pieces of research and illustration work last winter we brought in a quantity of frozen wheat from the Northwest. In the course of feeding 177 bushels of it, from the 1st of March until the 24th of May, we found that we obtained eight dozens of eggs per bushel of wheat. We expect by illustrations of those simple, economical and common methods to evolutionize the whole business of poultry-keeping in Quebec, and I shall be glad to learn that a like improvement is effected in New Brunswick. This spring we shall have between three and four thousand young chickens. In the autumn we shall have a good many cockerels bred from several generations of selected hens, that have laid well during the winter. These cockerels will be for sale to farmers at \$1.00 each. Our Poultry Department attracts perhaps as much attention as any part of our work at Macdonald College. I do not think there is a single department of agricultural work in Canada that would not respond as well as the poultry has done. We are hoping that similar principles and methods will become effective in every department of agriculture and of rural life.

Some Lessons from Denmark.

Some twenty-two years ago I paid a brief visit to the little kingdom of Denmark, which had then started on a course of development by improved agriculture. Denmark had become one of the poorest nations in Europe. Two of her richest provinces had been taken by Germany, but the courageous and tenacious Danes were not altogether cast down on that account. Under the leadership of public-spirited citizens they started in to improve the agriculture of the nation as a means of saving it from stagnation. Under the Royal Agricultural Society they selected a number of the best farmers and farms they could find, and arranged to have selected young men spend three months, or longer, on a number of those farms in turn. These young men, who might be called apprentice students, wrote articles on what they observed, what they did and what they learned. Returning to their own homes they helped to put into practice

the best methods they had acquired. In a short time the knowledge of the best farming methods in the kingdom were available to the farmers in every locality. At the same time they carried on a systematic improvement of the education in their rural schools, looking towards training the young people into ability for life at its best in their own locality.

If our rural schools are to be supplied with really capable teachers we must hereafter have higher paid teachers. We can no longer get well trained teachers to teach in rural schools at the salaries they have been receiving. Salaries are to go up; and teachers with adequate scholarship, training and experience must be paid better salaries. It would pay New Brunswick and every other part of Canada to give more attention to education in the rural districts. The progress of the province in wealth and material prosperity depends largely on its agriculture; and in future that must be affected greatly by the sort of education in the elementary rural schools.

The little kingdom of Denmark sends to England some of the same sort of products as Canada. And Denmark received in 1903, \$8,400,000 more than other competing countries would have received in the same markets for an equal quantity of the products, butter, bacon and eggs. That was the premium obtained by the Danes for superiority of quality and condition. Denmark has had the kind of schools I advocate for thirty years. The rural population has been educated towards ability, intelligence in regard to rural life, and the public spirit that makes for successful co-operation. That little kingdom receives from England an immensely larger amount for her farm products than any other country, for equal quantities. That is the premium for superior education.

Much of it originates in the rural schools. It leads on to co-operations in many rural activities. Co-operative creameries, co-operative bacon-curing establishments, cow-testing associations are but instances.

Taxation for Education Produces Wealth.

The total amount paid in Canada for the education of all of the 890,000 children in the rural districts is just about \$8,500,000 a year, or the amount which the wise and worthy people of that little kingdom obtained as a premium for superior quality in three products exported to Great Britain. Denmark is now one of the wealthiest nations in Europe in proportion to area and population, excelling in agriculture even England herself. From among the poorest thirty-five years ago to the wealthiest in agriculture to-day is a praiseworthy achievement. The transformation was accomplished largely by the practical agricultural education I have outlined, the improvement of rural schools and the development of co-operation. The people as a whole were interested and enthusiastic in their support of the movement. I found one clergyman who had a class of girls coming to his house to learn cooking and good housekeeping from his wife. Let us together work out our own salvation was the call and the action of the whole nation, and money was ungrudgingly spent on education.

Would you like to advocate increased local taxation for schools at the risk of upholding an unpopular cause? When a man seeks public office, too often he endeavours to get in by advocating lower taxation. What is taxation? Taxation under our institutions of government of the people, by the people, for the people? Everybody chipping in to do for each and for all what could not be done so well or could not be done at all by individual action alone. We cannot have better schools without better teachers; we cannot have better teachers in rural schools without better salaries; and we cannot have better salaries unless the people tax themselves. There is high public spirit in paying taxes for schools. 'Bear ye one another's burdens and so fulfil the law of Christ,'—and (may I add?) of Christian civilization. If we refuse to uphold taxation to the extent of the community's needs and of our ability to pay, we are getting away from the first principles of Christianity. Taxes for schools must go up or we, as a

people, must go down. We want our citizens to cherish intelligence, liberty, justice and goodwill, and these are to be inculcated in the school house. Therefore, become advocates—unpopular though it may be—of increased taxation for better schools. Money wisely spent on schools is well invested—invested where 'neither moth nor rust doth corrupt and where thieves do not break through nor steal.'

Evolution of Schools

New Brunswick, with a larger area and no less valuable natural resources could do as much or more than Denmark. It can be done by means of education ; education adapted to the conditions and needs of the province at this present time. Education in this sense does not mean alone reading, writing and figuring.

Education is a word of many meanings—an elusive term difficult of definition, often used to represent experiences unlike in their nature. It is not a something or subject detachable from life. It may consist of, or result from, a series of experiences arranged to lead to the increase of (a) knowledge, (b) power, ability, and skill, and (c) good-will in individuals and in the community. For those who hold that the primary aim of education should be to qualify a person to earn a living, its progress will be denoted by the application of ever-increasing intelligence, ability, and good-will to meet the needs of food, clothing, shelter, and all of material good that these types stand for. But since to earn a living is not the main purpose of life, education must also be a series of experiences leading one to make life itself worth living. That can be done by the unfaltering quest of truth, beauty, and goodness. Everybody is concerned in those, and an interest in education is at the beginning of wholesome enthusiasm for those and for humanity.

Of old, the informing and training of the children were carried on in the homes and at the occupations of the family. Then, for reasons of economy and efficiency, formal education was taken up by public and representative bodies—ulti-

mately by governments, as representing the whole people. Out of these efforts came schools as we know them—to conserve knowledge, to impart it, and more than that, to train youth for life at its best, at the time and in the locality. The experiences of a people change with the development of individuals, of civilization, and of the conditions of life. To meet these changes, there must come to the schools, ever and ever and ever, reforms, additions, and advances, unless the race itself is to stand still. We are carrying on experiments in governments and in schools. A free people will keep on making experiments—going on from every new advantage gained.

The first schools were private, with self-appointed teachers, and existed chiefly to teach letters, or reading and writing. Then came church schools, with their fees and their catechisms. Then came public schools, maintained by the taxes of all the people for the good of all the people. Under that system, contributions in our Dominion are made by the provincial governments, municipal authorities, and rate-payers of school sections. Governmental authority controls the courses of study, the qualifications of teachers, to some extent their remuneration, and also the text books and regulations.

If our future as a nation is to be satisfying, it must needs be that the teacher shall be recognized as a leader and not merely as a teacher of letters. For leadership, he must have powers of sympathy, insight, and interpretation; and to secure a following of the people, as well as of the children, he must be possessed of skill, scholarship, and energy; and with all these have a character animated by enthusiasm, unselfishness, and purpose to serve. National suicide lies in the direction of belittling the teachers. National safety and progress in all worthy ways must follow from competent leaders, trained into ability to meet conditions arising from the old in human nature and circumstances created by the new in man's ever-increasing control of Nature.

The Love of Labor.

Education is for the benefit of the pupil as an individual, as a coming citizen, and as one link in the chain of life. The powers resulting from it may be applied to the improvement of, (a) the home and its comforts, conveniences, safeguards, and spirit ; (b) the occupation and the security of its opportunities, satisfactions, and remunerations ; and (c) the social relationships, in order that there may be an increase of good-will and co-operation.

Such applications of education would bring about what has been called the rehabilitation of rural life. As a means towards that end, there are required schools in which children work with their hands on tangible things, and can themselves take the initiative in tasks which are mutually helpful to the children and to the relationship of the school to the homes. By means of such schools there would be conserved a love of manual labor, a love of ideas and learning, and a love of one's fellows. These foster and nourish worthy enthusiasm for all good things. It would be well to have in such a school difficulties to be encountered and overcome somewhat similar to those of later life. That may be stated as a good reason for commending manual training, household science, and nature study with the school garden. These lend themselves to the graduation of difficulties, to situations in which children learn from each other, and to experiences which cultivate the imagination and at the same time develop executive ability. After a few centuries of such schools one might expect men and women to be on the average the peers of Tennyson and Florence Nightingale. What would not the peaks of human life be then ? It may not be long before the courses of study in our public schools provide such fair balance for the application of children's activities, that time-tables will be arranged with one-quarter of the whole time devoted to doing things with the tangible, one-quarter to language, literature, and history, and the remainder divided between mathematics and nature sciences.

For the Future.

Concurrently with the improvement and advancement of education, there is needed further organization of the factors which make for the improvement of the operations as well as the management of agriculture. May I venture to express the hope, Mr. Commissioner, that your Departement will take such steps as to organize still more effectively the agencies for the advancement of agriculture, and that under your fostering care that great interest and industry will make still greater progress than has been accomplished in the past. There is still opportunity for a forward movement in agricultural education and organization that will make a new era in New Brunswick. For myself, if I were not Principal of Macdonald College, I would count it a great privilege and honor to be Commissioner of Agriculture here, with a free hand for a few years, to give the best service to the province of which I am capable. Never before in the history of civilization has there been the same call or the same need for improvement in the rural districts as at the present time.

A feeling of restlessness, of change, of chafing under existing conditions is abroad among the people. That is not wholly new, but there is a comparatively new feature in the unrest. Instead of the movement being all city-ward, there is now a tendency, an instinct, an inclination to get back to the land, to stay on the land for the sake of the homes and the families, for the sake of health and security in opportunity of employment, and for the advancement of worthy education.

To advance the education of the people is the highest privilege as it is the most important duty of statesmanship. Would parliaments and legislatures and county councils, and the whole list of them, be worth while unless they led towards the fruits of better education? Of all the forms of help which a government, representing all the people, may with safety and benefit give to individuals, the best are those which help to develop intelligence, power, ability, skill, and co-operation with good-will.

Practical Illustrations.

It is worth while to help to bring about one really good rural school, in every way adapted to the needs of the people of the locality. It is worth while to endeavor to have such a school repeated, over and over and over again, until the whole land is in the way of being transformed by their influence.

It is worth while to try to bring about an illustration farm, in every way providing satisfying occupation in a rural district at its best. Such a farm would cause its essential features, and the fundamental principles that determine its quality, to be repeated and applied over and over again. Wherever it prevailed would thereby become part of the new earth. It is worth while to try to have an illustration rural home at its very best in all its appointments, in all its activities, and in all its spirit.

Where the school, the occupation, and the home are each at their best, and in numbers at their very best in any locality, there you would have an illustration rural community worth studying by all men who are concerned for the weal of their fellows. Where it prevailed would become part of the new heaven—and of the new earth wherein dwelleth righteousness. To have seen such places, to have known of their real merits, would bring to every intelligent toiler for the betterment of conditions and of life, fresh confidence, renewed courage, and enlarged enthusiasm for education and for life.

We at Macdonald College would like to help you in the Province of New Brunswick. If you will send some of your young men and young women whom you want to have trained into competent leadership for the rural districts and intrust them to our care, we will do the best we can for them and through them for you. I hope to live long enough to see a School Garden an integral part of education in almost every rural school in the province. I hope you may be able

to found for yourselves a School or a College of Agriculture, and a Department of Household Science both allied with your Normal School and with your University. In that way educational effort would be recognized as working directly for the improvement of the occupations and the betterment of the homes of the people ; while teachers would be trained as competent guides and friends for the children who are to occupy the homes and follow the activities of rural life in New Brunswick. And as years go by we shall all unite in congratulating whoever may be Commissioner of Agriculture on the progress of the province.

